

जिल्हा वार्षिक योजना : अपारंपरिक ऊर्जा
संयंत्रे आस्थापित करण्याच्या योजनांच्या
अंमलबजावणीची कार्यपद्धती

महाराष्ट्र शासन

उद्योग, ऊर्जा व कामगार विभाग

शासन निर्णय क्रमांक: योजना-२०१३/प्र.क्र.७४/ऊर्जा-७.

मादाम कामा मार्ग, हुतात्मा राजगुरु चौक,

मंत्रालय, मुंबई - ४०० ०३२.

तारीख: ५ जुलै, २०१३.

प्रस्तावना —

अपारंपरिक ऊर्जा हा अखंड उपलब्ध असणारा ऊर्जा स्रोत असून दैनंदिन ऊर्जेच्या गरजा काही प्रमाणात भागविण्यासाठी त्याचा वापर करणे शक्य आहे. राज्यामध्ये अपारंपरिक व नित्यनूतनशील ऊर्जा स्रोतांवर आधारित संयंत्रांचा वापर वाढावा यासाठी अधिकाधिक ठिकाणी त्यांची आस्थापना होणे आवश्यक आहे. त्यासाठी अपारंपरिक ऊर्जा स्रोतांवर आधारित विविध संयंत्रांची आस्थापना जिल्हा वार्षिक योजनेतील कार्यक्रमांद्वारे करण्यात येते. त्याअनुषंगाने जिल्हा वार्षिक योजनेतील अपारंपरिक ऊर्जा संयंत्रांच्या कार्यक्रमातील विविध योजनांच्या अंमलबजावणीसाठी आवश्यक तांत्रिक निकषांसह सुयोग्य कार्यपद्धती निर्गमित करण्याची बाब शासनाच्या विचाराधीन होती.

शासन निर्णय—

अपारंपारीक ऊर्जा स्रोतांवर आधारित विविध संयंत्रांची आस्थापना जिल्हा वार्षिक योजनेतील कार्यक्रमांद्वारे नियोजन विभागाकडून करण्यात येते. जिल्हा वार्षिक योजनेअंतर्गत राबविण्यात येणाऱ्या अपारंपरिक ऊर्जा कार्यक्रमातील सौर चूल, सौर पथदीप, सौर घरगुती दिवे, सौर उष्णजल संयंत्र, सौर कंदील, सौर पंप ही संयंत्रे आस्थापित करावयाच्या योजनांसाठी पुढीलप्रमाणे तांत्रिक बाबी व परिमाण तसेच कार्यपद्धती याद्वारे विहित करण्यात येत आहे.

➤ अपारंपरिक ऊर्जा संयंत्रांच्या तांत्रिक बाबी व परिमाण :-

१) सौर चूल :-

• पेटी प्रकारची (बॉक्स टाईप) सौर चूल :-

सदर सौर चूल सर्वसाधारणपणे अँल्युमिनियम पेटी सारखी दिसते. यामध्ये मुख्यत्वे बाहेरील पेटी, अन्न शिजविण्यासाठी आतील पेटी, आरसा व अँल्युमिनियमची भांडी इत्यादींचा समावेश असतो.

• **डिश प्रकारची सौर चूल :-**

डिश प्रकारच्या सौर चुलीचे प्रामुख्याने दोन प्रकार आहेत. या प्रकाराच्या सौर चुली सहजपणे हाताळता येण्यासारख्या असून सर्व प्रकारचे अन्न शिजविण्यासाठी त्यांचा उपयोग होतो.

अ) एस.के.-१४ प्रकारची सामुदायिक सौर चूल :-

या सामुदायिक सौर चुलीवर साधारणत: १० ते १५ विद्यार्थ्यांचे अन्न शिजविता येते. या सामुदायिक सौर चुलीवर आपला नेहमीचा प्रेशर कुकर वापरून साधारणत: २० ते २५ मिनिटांमध्ये अन्न शिजविता येते. या सौर चुलीमध्ये अँल्युमिनियमचा पत्रा असलेला रिफ्लेक्टर, लोखंडी फ्रेम, ट्रॅकिंग सिस्टिम, ५ लिटरचे प्रेशर कुकर इ. भागांचा समावेश असतो.

ब) एस.के.-२३ प्रकारची सामुदायिक सौर चूल :-

या सामुदायिक सौर चुलीवर साधारणत: ४० ते ५० विद्यार्थ्यांचे अन्न शिजविता येते. या सामुदायिक सौर चुलीवर आपला नेहमीचा प्रेशर कुकर वापरून साधारणत: ३० ते ४० मिनिटांमध्ये अन्न शिजविता येते. या सौर चुलीमध्ये अँल्युमिनियमचा पत्रा असलेला रिफ्लेक्टर, लोखंडी फ्रेम, ट्रॅकिंग सिस्टिम, १५ लिटरचे प्रेशर कुकर इ. भागांचा समावेश असतो.

२. सौर पथदीप :-

केंद्र शासनाकडून निश्चित केलेल्या तांत्रिक परिमाणानुसार सौर पथदीपांच्या मुख्य घटकांमध्ये ७४ वॅ. फोटोव्होल्टाईक मोड्युल, ११ वॅ. चा एक सी.एफ.एल. दिवा, ७५ ए. एच. बॅटरी, इलेक्ट्रॉनिक नियंत्रक व पथदीप लावण्यासाठी आवश्यक खांब इ. साहित्याचा समावेश असतो. सौर पथदीपांमध्ये असलेल्या इलेक्ट्रॉनिक नियंत्रकामुळे संध्याकाळ झाल्यावर पथदीप आपोआप सुरु होतात व पहाट झाल्यावर बंद होतात. अशा सौर पथदीपांद्वारे दररोज आवश्यक सूर्यप्रकाश उपलब्ध असल्यास साधारणत: ९०० ल्युमेन्स (४

मी. उंचीवरुन) एवढा प्रकाश मिळतो. यामध्ये एल.ई.डी. प्रकाराचे सौर पथदीप देखील उपलब्ध आहेत.

३. सौर घरगुती दिवे :-

सौर घरगुती दिवे (प्रकार-१ ते ४) यामध्ये ९ व ११ वॅ. क्षमतेचे सी.एफ.एल., इन्वर्टर, इलेक्ट्रॉनिक्स, बॅटरी इत्यादी भागांचा समावेश असतो. हे घरगुती दिवे घरांमध्ये सुलभरित्या वापरता येतात. यामध्ये एल.ई.डी. प्रकाराचे सौर घरगुती दिवे देखील उपलब्ध आहेत.

४. सौर उष्णजल संयंत्र :-

सौर उष्णजल संयंत्रामध्ये सूर्याची किरणे सौर संकलकावर एकत्रित करून त्यापासून औष्णिक ऊर्जा तयार केली जाते. ही औष्णिक ऊर्जा पाण्याला दिली जाते व त्यामुळे पाण्याचे तापमान वाढते. तापलेले पाणी सर्व बाजूंनी उष्णतारोधक केलेल्या भागामध्ये एकत्रित केले जाते. त्यामुळे औष्णिक ऊर्जेचा अपव्यय टाळता येतो.

सौर उष्णजल संयंत्राच्या संकलकाच्या वरील भागास काचेचे आवरण असते. संकलकामध्ये तांब्याच्या पत्र्यामध्ये तांब्याच्या नलिका बसविलेल्या असतात. या नलिकांना वरच्या (आकाशाकडील) पृष्ठभागास काळा रंग दिलेला असतो. त्यामुळे उन्हाने पत्रा व नलिका तापतात व नलिकामध्ये पाणीही तापते. पाणी तापल्यामुळे हलके होऊन वरील गरम पाण्याच्या टाकीमध्ये साठविले जाते व टाकीमध्ये खालचे गार पाणी नलिकामध्ये येते. संयंत्र आस्थापित करीत असताना संकलकाचा पृष्ठभाग दक्षिणेकडे झुकलेला असतो.

सौर उष्णजल संयंत्र हे ३००० लिटर्स प्रतिदिन क्षमतेपर्यंत नैसर्गिक अभिसरण (थर्मोसायफन) व ३००० लिटर्स प्रतिदिन क्षमतेच्या वर बलपूर्वक अभिसरण (फोर्स सर्क्युलेशन) या प्रकारात उपलब्ध आहे. यामध्ये सौर संकलक, गरम पाण्याची टाकी, थंड पाण्याची टाकी व पाईपलाईन इ. बाबींचा समावेश असतो.

५. सौर कंदील :-

सौर कंदील हे सौर प्रकाशीय विद्युत कार्यप्रणालीवर अवलंबून आहे. सौर कंदील वजनाला हलके व कुठेही सहज नेता येणारे उपकरण असून वापरास उपयुक्त आहे. सौर कंदील हे दोन प्रकारांमध्ये उपलब्ध आहेत. यामध्ये १० व १२ वॅ. क्षमतेचे सौर फोटोव्होल्टाईक मोड्युल, ७ वॅ. सी.एफ.एल., इलेक्ट्रॉनिक्स, विद्युतघट (बॅटरी), प्रोटेक्शन सिस्टीम इ. चा समावेश असतो. सौर कंदीलापासून सुमारे २३०/३७० ल्युमेन्स इतका

प्रकाश मिळतो.पूर्ण भारित सौर कंदील ३-४ तासांपर्यंत वापरता येतो.यामध्ये एल.ई.डी. प्रकाराचे सौर कंदील देखील उपलब्ध आहेत.

६. सौर पंप :-

या संयंत्रात सौर ऊर्जेचे रूपांतर विद्युत ऊर्जेत होऊन ती पंपाला पाणी उपसा करण्यासाठी पुरविली जाते. १००ते ४५०० वॅट क्षमतेच्या सौर मोड्युलपासून १ ते ५ एच.पी. क्षमतेचे पंप चालविले जातात. या पंपापासून साधारणतः १५ मी. खोलीपासून १५,००० ते २,५०,००० लिटर्स प्रतिदिन पाणी उपसा होऊ शकतो. हे प्रमाण जमिनीचा प्रकार, पाण्याची खोली व पाणी व्यवस्थापन यावर अवलंबून आहे. सौर पंपामध्ये विद्युतघट (बॅटरी) नसल्याने तो सूर्यप्रकाश असतानाच कार्यरत राहतो.

➤ संयंत्र आस्थापनेसाठी योजनांच्या अंमलबजावणीची कार्यपद्धती :-

- अपारंपरिक ऊर्जा संयंत्रांची आस्थापना करण्यासाठी सर्वेक्षण करून सर्व आवश्यक माहिती संकलित करावी. सर्वेक्षणानंतर आस्थापित करावयाच्या संयंत्राची क्षमता, संख्या व प्रकार यांची निश्चिती करण्यात यावी. त्यानुसार प्रकल्प अहवाल तयार करावा.
- अपारंपरिक ऊर्जा स्रोतांची संयंत्रे आस्थापित करण्यासाठी आर्थिक तरतूद, वापर करणाऱ्याचा हिस्सा, निवडीचे निकष, कार्यान्वयन यंत्रणा इ.बाबी स्थानिक परिस्थिती विचारात घेऊन प्रशासकीय मान्यता देण्याच्या प्राधिकाऱ्याने निश्चित कराव्यात. योजना तयार करून त्यास सक्षम प्राधिकाऱ्याने प्रशासकीय मान्यता प्रदान करावी.
- प्रकल्प अहवालास संबंधित तांत्रिक विभागाच्या सक्षम प्राधिकाऱ्याकडील तांत्रिक मान्यता घेण्यात यावी. सदर तांत्रिक मान्यता देण्यासाठी सार्वजनिक बांधकाम विभाग/जलसंपदा विभाग/जिल्हा परिषद यांच्याकडील अभियंता, नगरपालिका/महापालिका यांच्याकडील अभियंता, महाराष्ट्र जीवन प्राधिकरण यांच्याकडील अभियंता, कृषि विकास अधिकारी यासारखे अधिकारी त्यांच्याकडील तांत्रिक व आर्थिक अधिकारानुसार सक्षम राहतील.
- प्रशासकीय व तांत्रिक मान्यता प्राप्त झाल्यावर संबंधित कार्यान्वयन यंत्रणे अपारंपरिक ऊर्जा संयंत्रे आस्थापित करण्यासाठी प्रचलित पद्धतीचा अवलंब करावा. त्यासाठी महाऊर्जाच्या दरकराराचा वापर करता येईल.

- संयंत्रे आस्थापित झाल्यानंतर ती वापर करणाऱ्या यंत्रणेला/कार्यान्वयन यंत्रणेला हस्तांतरित करण्यात यावीत. संयंत्र आस्थापनेनंतर ५ वर्ष देखभाल व दुरुस्ती तसेच संयंत्र कार्यरत ठेवण्याची जबाबदारी संबंधित उत्पादक/पुरवठादार यांची राहील. परंतु संयंत्राची दैनंदिन देखभाल करण्याचे काम वापर करणाऱ्या यंत्रणेकडून/कार्यान्वयन यंत्रणेकडून करण्यात येईल. त्यासाठी वापर करणाऱ्या यंत्रणेने/कार्यान्वयन यंत्रणेने विशिष्ट अधिकाऱ्यास प्राधिकृत करावे. संयंत्रे आस्थापित झाल्यानंतर दैनंदिन देखभाल व्यवस्थापनाविषयी उत्पादक/पुरवठादारामार्फत प्रशिक्षण देण्यात यावे.
- संयंत्रे आस्थापित झाल्यानंतर ५ वर्षांचा कालावधी हा उत्पादक/पुरवठादाराचा हमी कालावधी राहील. सदर कालावधीत उत्पादक/पुरवठादाराने प्रत्येक तिमाहीस एकदा संयंत्रास भेट देऊन सर्व्हिसिंग करावे. दर तिमाहीस संयंत्र कार्यरत असल्याबद्दल अहवाल उत्पादक/पुरवठादाराने या कामासाठी प्राधिकृत केलेल्या अधिकाऱ्यांच्या संयुक्त स्वाक्षरीनिशी वापर करणाऱ्या यंत्रणेस/ कार्यान्वयन यंत्रणेस पाठवावा. संयंत्र कार्यरत असल्याबद्दल वाषिक अहवाल देखील उत्पादक/पुरवठादाराने प्राधिकृत अधिकाऱ्यांच्या संयुक्त स्वाक्षरीने वापर करणाऱ्या यंत्रणेस/ कार्यान्वयन यंत्रणेस पाठविण्यात यावा. हमी कालावधीनंतर संयंत्राची देखभाल दुरुस्ती करण्याकरिता संयंत्र उत्पादक/पुरवठादार यांच्याबरोबर वार्षिक दुरुस्ती करार करून संबंधित वापर करणाऱ्या यंत्रणेने/ कार्यान्वयन यंत्रणेने संयंत्र कार्यरत ठेवण्याची खात्री करावी.
- ५ वर्षांच्या हमी कालावधीत सुट्या भागासह देखभाल व दुरुस्तीसह (CMC) करारनामा उत्पादक/पुरवठादार संस्थेकडून रु.१००/- च्या स्टॅम्प पेपरवर करून घेण्याची दक्षता कार्यान्वयन यंत्रणेने घ्यावी.
- आस्थापित करावयाच्या संयंत्रांची तांत्रिक मोजमापे (Technical Specifications) या सोबतच्या परिशिष्टाप्रमाणे राहतील. या व्यतिरिक्त अपारंपरिक ऊर्जा संयंत्रांचा कार्यक्रम राबवावयाचा असल्यास त्याबाबत तांत्रिक सल्ला महाऊर्जाकडून उपलब्ध करण्यात येईल. तांत्रिक मोजमापे (Technical Specifications) अद्यावत करण्यात आल्यास महाऊर्जाकडून त्याबाबत मार्गदर्शक सूचना निर्गमित करण्यात येतील.

सदर शासन निर्णय महाराष्ट्र शासनाच्या www.maharashtra.gov.in या संकेतस्थळावर उपलब्ध करण्यात आला असून त्याचा संकेताक २०१३०८१४१७१८४४८५१० असा आहे. हा आदेश डिजीटल स्वाक्षरीने साक्षांकित करून काढण्यात येत आहे.

महाराष्ट्राचे राज्यपाल यांच्या आदेशानुसार व नावाने.

(मी.भा.निकम)

कार्यासन अधिकारी, महाराष्ट्र शासन.

प्रत,

१. मा.राज्यपाल यांचे प्रधान सचिव, राजभवन,मुंबई.
२. मा. मुख्यमंत्री, महाराष्ट्र राज्य यांचे प्रधान सचिव, मंत्रालय,मुंबई.
३. मा.मंत्री(न. व न.ऊ.) यांचे विशेष कार्य अधिकारी, मंत्रालय,मुंबई.
४. मा.राज्यमंत्री(न. व न.ऊ.) यांचे खाजगी सचिव, मंत्रालय,मुंबई.
५. मुख्य सचिव,महाराष्ट्र राज्य, मंत्रालय,मुंबई.
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TECHNICAL SPECIFICATION FOR SOLAR COOKER

A) SPECIFICATIONS OF BOX TYPE SOLAR COOKER

	Technical Conditions
Type	Solar Cooker having box, top cover, tray & three pots of aluminum material as per IS 13429 part I to III
Cover plate	Cover plate shall be double glazed as per IS 13429 part I to III
Cooker Size	Size: - 500(± 10) x 500(± 10) x 170 (± 10) mm without caster wheel
Mirror	Mirror shall be free from bubbles and waviness having minimum 65 percent solar reflectance and its reflecting area shall not less than the glazing area (size 445 x 445) (± 10) mm
Cooking Pots	No. of pots 3 having diameter 160(± 10)mm, Height 70 (± 10)mm
Caster Wheel	Caster wheels having ball bearing (IS 5932) :- 4 no's.
Insulation	Insulation shall be provided at site (25 mm) and bottom (50 mm) having thermal resistance (R) shall be minimum 0.96 $\text{m}^2 \text{^0C/W}$
Cooking tray	Cooking tray shall be of aluminum / copper having thickness as 0.5 mm and inner surface shall have mat black finish with bottom size 325 x 325 (± 5) mm and height 70 (± 5) mm
Useful Cooking Area	Useful area should be: - 375 x 375 (± 10) mm
Test Certificate	Approved by authorized BIS test centers
Type certification	IS 13429 part I to III

B) SPECIFICATIONS OF DISH TYPE SOLAR COOKER – (SK- 14)

Technical Specifications

- Material of reflectors : Aluminum sheets of thickness 0.4 mm
- Reflectivity : 75% minimum
- Size of focal spot : 100 mm appx.
- Focal length : 280 mm
- Dimension & shape : 1.4 meter diameter parabolic
- Surface area of reflector : 2.20 Sq.m.
- Aperture area of reflector : 1.54 Sq.m.
- Tracking of the sun : Manual
- Cooking vessel : Pressure cooker (ISI) of 5 litter capacity;
Powder coated black from bottom.
- Other accessories : Cap, Hand gloves & Goggles of
good quality
- Power availability at cooking pot : About 0.6 KW (With over 600 W/Sq.m.
direct / 750 W/sq.m. total solar
insulation available on reflector)
- Thermal efficiency : Over 40%
- Life
 - i. Metallic structure high wind speeds. : 20 years. It should be able to withstand
 - ii. Reflecting mirrors : Minimum 5 years

C) SPECIFICATIONS OF COMMUNITY SOLAR COOKER – (SK-23)

Technical Specifications

- Material of reflectors : Aluminum sheets of thickness 0.4mm
- Reflectivity : 75% minimum
- Size of focal spot : 340 mm approximate minimum
- Focal length : 400 mm minimum
- Dimension & shape : 2.3 meter diameter community Solar Cooker
- Surface area of reflector : 4.79 Sq. m.
- Aperture area of reflector : 4.15 Sq. m.
- Tracking of the sun : Manual
- Cooking vessel : Pressure cooker (ISI) of 15 ltr. Capacity; Powder coated black from bottom.
- Other accessories : Cap, Hand gloves & Goggles of good quality
- Power availability at cooking pot : About 2.5 KW (With over 600 W/Sq.m. direct / 750 W/sq.m. total solar insulation available on reflector)
- Thermal efficiency : Over 40%
- Life
 - i) Metallic structure : 20 years. It shall be able to withstand high Wind speeds.
 - ii) Reflecting mirrors : Minimum 5 years

TECHNICAL SPECIFICATION OF SOLAR STREET LIGHTING SYSTEMS:

- **DEFINITION:**

A stand alone solar photovoltaic (SPV) street lighting system (SLS) is an outdoor lighting unit used for illuminating a street or an open area. It consists of photovoltaic (PV) module(s), compact fluorescent lamp (CFL), lead acid battery, control electronics, inter-connecting wires/cables, module mounting Pole including hardware and battery box. The CFL is fixed inside a luminaire which is mounted on the pole. The PV module is placed at the top of the pole at an angle to maximize incident solar radiation, and a battery is placed in a box attached to the pole. The module is mounted facing south, so that it receives solar radiation throughout the day, without any shadow falling on it. Electricity generated by the PV module will charge the battery during the day time. This system operates from dusk to dawn.

- **TECHNICAL SPECIFICATIONS & GENERAL SPECIFICATIONS:**

- 1) **DUTY CYCLE:**

The system should automatically switch is ON at dusk, operate throughout the night and automatically switch is OFF at the dawn.

- 2) **PV MODULE (S) :**

- a. Both crystalline and thin film technology modules are allowed in the system. The PV module should have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 or IEC 61646 for crystalline and thin film PV modules respectively. The manufacturer should produce the certificate for a higher wattage module, in case the certificate is not available for the offered PV module. Further, the manufacturer should certify that the supplied module is also manufactured using similar material, design and process as that of the certified PV module. The certificate should be from an NABL or IECQ accredited Laboratory.
- b. The power output of the module(s) under STC should be a minimum of 74 Wp. Either two modules of minimum 37 Wp output each or one module of 74 Wp output should be used. In case of thin film technology PV modules, the specified values refer to the stabilized power output after the initial degradation. **The module efficiency should not be less than 12%.**
- c. The operating voltage corresponding to the power output mentioned above should be 16.4 ± 0.2 V.
- d. The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.
- e. The terminal box on the module should have a provision for opening for replacing the cable, if required.
- f. Each PV module must use a RF identification tag (RFID), which must contain the following information:
 - (i) Name of the manufacturer of PV Module.
 - (ii) Model or Type Number

- (iii) Serial Number
- (iv) Month and year of the manufacture
- (v) I-V curve for the module
- (vi) Peak Wattage of the module at 16.4 volts
- (vii) I_m , V_m and FF for the module
- (viii) Unique Serial No and Model No of the module

Until March 2013, the RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions. **However from 1st April 2013 onwards; RFID shall be mandatorily placed inside the module laminate.**

- (g) **A distinctive serial number starting with NSM will be engraved on the frame of the module. The distinctive number starting NSM will also be screen printed on the tedlar sheet of the module.**

3) BATTERY

- (i) Lead Acid, tubular positive plate flooded electrolyte or Gel or VRLA Type.
- (ii) The battery will have a minimum rating of 12V, 75 Ah (at C/10 discharge rate).
- (iii) 75 % of the rated capacity of the battery should be between fully charged and load cut off conditions.

4) LAMP

- (i) The lamp should be 11 Watt compact fluorescent lamp (CFL) with 4 pins along with proper pre-heating circuit.
- (ii) The light output from the lamps should be around 900 ± 5 % lumens (for 11 W CFL).
- (iii) The lamp should be housed in an assembly suitable for outdoor use, with a reflector on its back.
- (iv) No blackening or reduction in the lumen output by more than 10%, should be observed after 1000 ON/OFF cycles (two minutes ON followed by four minutes OFF is one cycle).

5) ELECTRONICS

- (i) The inverter should be of quasi sine wave/ sine wave type, with frequency in the range of 20 - 30 KHz. Half-wave operation is not acceptable.
- (ii) The total electronic efficiency should be not less than 85 %.
- (iii) The idle current consumption should not be more than 10 mA.

- (iv) The PV module itself should be used to sense the ambient light level for switching ON and OFF the lamp.

6) ELECTRONIC PROTECTIONS

- (i) Adequate protection is to be incorporated under no load conditions e.g. when the lamp is removed and the system is switched ON.
- (ii) The system should have protection against battery overcharge and deep discharge conditions.
- (iii) Fuses should be provided to protect against short circuit conditions.
- (iv) Protection for reverse flow of current through the PV module(s) should be provided.
- (v) Electronics should have temperature compensation for proper charging of the battery throughout the year.

7) MECHANICAL HARDWARE

- (i) A metallic frame structure (with corrosion resistance paint) to be fixed on the pole to hold the SPV module(s). The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that the module(s) can be oriented at the specified tilt angle.
- (ii) The pole should be made of mild steel pipe with a height of 4 metres above the ground level, after grouting and final installation. The pole should have the provision to hold the weather proof lamp housing. It should be painted with a corrosion resistant paint.
- (iii) A vented, acid proof and corrosion resistant painted metallic box for outdoor use should be provided for housing the battery with a provision of lock and Key.

8) OTHER FEATURES

- (i) The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery.
- (ii) There will be a Name Plate on the system, which will give:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Serial Number.
- (iii) Components and parts used in the solar street lighting systems should conform to the latest BIS specifications, wherever such specifications are available and applicable.

(iv) **The PV module(s) will be warranted for a minimum period of 25 years from the date of supply and the street lighting system (including the battery) will be warranted for a period of two years from the date of supply.** PV modules used in Solar Street Lighting System must be warranted for their output peak watt capacity, which should not be less than 90% at the end of Twelve (12) years and 80% at the end of Twenty five (25) years.

The Warranty Card to be supplied with the system must contain the details of the system. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

(v) Necessary lengths of wires/cables and fuses should be provided.

(vi) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the Solar Street Lighting System. The following minimum details must be provided in the Manual:

- Basic principles of Photovoltaics.
- A small write-up (with a block diagram) on Solar Street Lighting System - its components, PV module, battery, electronics and luminaire and expected performance.
- About Charging and Significance of indicators.
- Clear instructions about erection of pole and mounting of PV module (s) and lamp housing assembly on the pole.
- Clear instructions on regular maintenance and trouble shooting of the Solar Lantern.
- DO's and DONT's.
- Name and address of the contact person for repair and maintenance, in case of non-functionality of the solar street lighting system.

WHITE LED BASED SOLAR STREET LIGHTING SYSTEMS:

- **DEFINITION**

White Light Emitting Diode (W-LED) is a solid state device which emits light when forward electric current passes through it. A LED based solar street lighting system consists of a PV Module, control electronics, battery, and W-LED based Luminaire, all suitably mounted on a Pole. The battery is charged by electricity generated through the PV module during day time and the luminaire provides light from dusk to dawn.

BROAD PERFORMANCE PARAMETERS

Light Source	White Light Emitting Diode (W-LED)
Light Out put	White colour (colour temperature 55000-65000K) minimum 15 LUX when measured at the periphery of 4 meter diameter from a height of 4 meter. The illumination should be uniform without dark bands or abrupt variations, and soothing to the eye. Higher light output will be preferred.
Mounting of light	Minimum 4 metre pole mounted
PV Module	40 Wp under STC, measured at 16.4 V at load. Module Voc minimum of 21V
Battery	Tubular Lead acid Flooded or Tubular GEL / AGM VRLA , 12 V- 40 AH @ C/10, Max DoD 75%
Electronics Efficiency	Min 85% total
Duty cycle	Dusk to dawn
Autonomy	3 days (Minimum 42 operating hours per permissible discharge

- **OTHER DETAILS**

- 1) **DUTY CYCLE**

The W-LED solar street lighting system should be designed to operate from dusk to dawn, under average daily insolation of 5.5 kWh /sq.m. on a horizontal surface.

- 2) **LIGHT SOURCE**

1. The light source will be a white LED type. Single lamp or multiple lamps can be used. The colour temperature of white LED used in the system should be in the range of 5500⁰K – 6500⁰K. Use of LEDs which emits ultraviolet light is not permitted.
2. The light output from the white LED light source should be constant through out the duty cycle.
3. The lamps should be housed in an assembly suitable for outdoor use. The temperature of heat sink should not increase more than 20^oC above ambient temperature even after 48 hrs of continuous operation. This condition should be

complied for the dusk to dawn operation of the lamp while battery operating at any voltage between the load disconnect and the charge regulation set point.

4. The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of white LEDs used in the lighting system must be furnished to the Test Centers and to the buyers. In absence of this data the solar street lights may not be tested by the Test Center.

3) BATTERY

Lead Acid, Tubular Positive Plate Flooded or Tubular GEL / AGM VRLA, 12 V- 40 AH @ C/10 discharge rate. Battery should conform to latest BIS standards. In view of non-availability of adequate test facilities for testing as per BIS standard in the country, existing facilities of battery manufacturers will be utilized by way of periodic quality audit by MNRE/BIS or their representative to ensure conformance of BIS standards.

- (i) Also initially for a period of six months from the date of the issue of these guidelines capacity test, Ampere-Hour (Ah) & Watt-Hour (Wh) efficiency test and charge retention tests per BIS standards may be used to enable the program to continue.
- (ii) It is also mandatory for the battery manufacturers/ bulk users to comply with batteries (Management and handling) Rules 2001 of MOEF, as amended.
- (iii) The manufacturer is required to submit the test report on Ah efficiency Wh efficiency and charge retention test from an NABL accredited Lab whereas the capacity test of the battery will be conducted by the system testing lab.
- (iv) At least 75 % of the rated capacity of the battery should be available between fully charged & load cut off conditions.

4) ELECTRONICS

- (i) **The total electronic efficiency should be at least 85%.**
- (ii) Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery throughout the year.
- (iii) The light output should remain constant with variations in the battery voltages.

5) PV MODULE

1. The PV module (s) shall contain mono/ multicrystalline silicon or thin film solar cells. In case of crystalline silicon solar cell module it is required to have certificate for the supplied PV module as per IEC 61215 specifications or equivalent National or International Standards whereas in case of thin film solar cell module it is required to have certificate for the supplied PV module as per IEC 61646 specifications or equivalent National or International Standards. In case of thin film modules for each model the modules should fulfill the wattage criterion after light soaking degradation.

In case the supplied PV module is not a module of regular production of the manufacturer and does not have certificate as above then the manufacturer should

have the required certification for at least one of the irregular modules. Further, the manufacturer should certify that the supplied module is also manufactured using same material design and process similar to that of certified PV module.

In case of imported modules it is mandatory to provide a copy of the international product qualification certificate to the test center.

2. The power output of the PV module must be reported under standard test conditions (STC) at 16.4 Volt loading voltage. I-V curve of the sample module should be submitted to the test center at the time of system qualification testing.
3. The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.
4. The terminal box on the module should have a provision for opening for replacing the cable, if required.
5. Identification and Traceability
Each PV module used in any solar power project must use a RF identification tag. The following information must be mentioned in the RFID used on each module (This can be inside or outside the laminate, but must be able to withstand harsh environmental conditions.)
 - a) Name of the Manufacturer or distinctive Logo
 - b) Model or Type No.
 - c) Serial No.
 - d) Year of make

6) ELECTRONIC PROTECTIONS

1. The system should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.
2. Fuse should be provided to protect against short circuit conditions.
3. A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the PV module(s). In case such a diode is not provided with the PV module, full protection against open circuit, accidental short circuit and reverse polarity should be provided.
4. Electronics should operate at 12V and **should have temperature** compensation for proper charging of the battery throughout the year.

7) MECHANICAL COMPONENTS

- (i) Metallic frame structure (with corrosion resistance paint) to be fixed on the Pole to hold the SPV module. The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45 degrees, so that it can be installed at the specified tilt angle.

- (ii) It should be possible to mount the light source on a metallic arm attached to the pole. The metallic arm for holding the light assembly should be extended at least 1.5 metres from the pole and set at a suitable angle to maximize uniform illumination of desired level over the specified area.
- (iii) A vented metallic/ plastic box with acid proof corrosion resistance paint for housing the storage battery outdoors should be provided.

8) OTHER FEATURES

- (i) The system should be provided with two LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged.
- (ii) There will be a Name Plate on the system body, which will give:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Model Number
 - (c) Serial Number
 - (d) Year of manufacture
- (iii) Necessary lengths of wires / cables and fuse should be provided

9) QUALITY AND WARRANTY

- (i) Components and parts used in White LED solar street lighting systems should conform to the latest BIS/ International specifications, wherever such specifications are available and applicable. A copy of the test report/ certificate stating conformity of BIS/ International standards must be submitted to the Test Centre.
- (ii) The PV module will be warranted for a minimum period of 20 years from the date of supply and the complete White LED solar street lighting system including the battery will be warranted for a period of at least 5 years from the date of supply.
- (iii) The original manufacturers of W-LED based solar street lighting system are required to provide to the Test Center a detailed report on the tests performance by them and the actually measured values of PV module, electronics, LEDs, battery and other related parameters, as per MNRE specifications. Mere mention of compliance to MNRE specifications is not acceptable and such samples may not be tested by the Test center. The test center will refer to the measured values provided by the manufacturer in the test report issued by the Test Center.

10) DOCUMENTATION

- (i) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar street lighting system. Besides other information the Manual should contain the following minimum details:
 - (a) About Photovoltaics.

- (b) A small write up (with a block diagram) on PV Module, electronics, lamps and battery.
- (c) About White LED solar street lighting system - its components and expected performance
The make, model number, country of origin and technical characteristics of W-LEDs should be stated in the product data sheet
- (d) Clear instructions about mounting of Pole, Grouting details, fixing of PV module, battery box and luminaire. Clear wiring instructions with line diagram
- (e) About significance of indicators
- (f) DO's and DONT's
- (g) Clear instructions on regular maintenance and trouble shooting of the system
- (h) Name and address of the person or service center to be contacted in case of failure or complaint.

TECHNICAL SPECIFICATION OF SOLAR HOME LIGHT SYSTEM:

A solar home lighting system (SHS), converts solar energy into electricity and provides a comfortable level of illumination in one or more rooms of a house. There are several SHS models featuring one, two, or four CFLs (Compact Fluorescent Lamps). The system could also be used to run a small DC fan or a 12-V DC television along with the CFL (s).

The SHS consists of a PV module of 18 or 37 or 74 Wp capacity, a lead-acid battery (of 12 V and 20 or 40 or 75 AH capacity respectively) and CFLs of 9 W or 11 W rating. The system is designed to work for three to four hours daily, with an autonomy of three days i.e. the system can function for three consecutive cloudy days.

A PV module is usually mounted on the roof of the house or any other convenient place so that it is exposed to direct solar radiation throughout the day, avoiding any shadow. The module converts incident solar radiation into electricity, which, in turn, charges the battery. The battery is placed inside the house. The battery provides power to the CFLs, and/ or the television/ fan as required. A charge controller prevents overcharging and deep discharge of the battery.

DUTY CYCLE

All the models of Solar Home Lighting Systems should be designed to operate for 3-4 hours daily. The actual duration of lighting could vary depending on the location and season, etc.

- Technical Specifications & General Specifications:**

Model	Component	Specifications
<u>Model-1</u> <u>One Light Point</u>	PV Module	1 x 18 W under STC
	Lamp	1 x CFL (9W/11W)
	Battery	1 x 12V, 20AH. Tubular Positive Plate flooded electrolyte, Lead Acid Battery or VRLA or Gel Type
	Others Components	Control electronics. Module mounting hardware, Battery box. Inter connecting wires / cables, Switches, Operation, instruction and maintenance manual.
<u>Model-2</u> <u>Two Lights</u>	PV Module	1 x 37 W under STC
	Lamp	2 x CFL (9W/11W)
	Battery	1 x 12V, 40AH. Tubular Positive Plate flooded electrolyte, Lead Acid Battery or VRLA or Gel Type.
	Others Components	Control electronics. Module mounting hardware, Battery box. Inter connecting wires/cables, Switches, Operation, instruction and maintenance manual.
<u>Model - 3</u>	PV Module	2 x 37 W or 1x74 W under STC

2 Lights & 1 Fan	Lamp	2 x CFL (9W/11W)
	Fan	1 x DC Fan (with wattage less than 20W)
	Battery	1 x 12V, 75AH. Tubular Positive Plate flooded electrolyte, Lead Acid Battery or VRLA or Gel Type.
	Others Components	Control electronics. Module mounting hardware, Battery box. Inter connecting wires/cables, Switches, Operation, instruction and maintenance manual.
Model - 4 4 Lights	PV Module	2 x 37 W or 1x74 W under STC
	Lamp	4 x CFL (9W/11W)
	Battery	1 x 12V, 75AH. Tubular Positive Plate flooded electrolyte, Lead Acid Battery or VRLA Gel Type.
	Others Components	Control electronics. Module mounting hardware, Battery box. Inter connecting wires/cables, Switches, Operation, instruction and maintenance manual.

Notes:

- i) All models should have a socket to provide power for a 12V DC TV set which can be purchased separately.
- ii) A small white LED could be provided as an optional feature, with an independent switch.

1) PV MODULE (S)

- (a) Both crystalline and thin film technology modules are allowed in the system. The PV module should have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286 or IEC 61646 for crystalline and thin film PV modules respectively. The manufacturer should produce the certificate for a higher wattage module, in case the certificate is not available for the offered PV module. Further, the manufacturer should certify that the supplied module is also manufactured using similar material, design and process as that of the certified PV module. The certificate should be from an NABL or IECQ accredited Laboratory.
- (b) The power output of the module(s) under STC should be a minimum of 18 Wp or 37 Wp or 74 Wp. In case of **Model-4** either two modules of 37 Wp each or one module of 74 Wp can be used. For thin film PV modules, the specified values refer to the stabilized power output after the initial degradation. **The module efficiency should not be less than 12%.**
- (c) The operating voltage corresponding to the power output mentioned above should be $16.4 \pm 0.2V$.

- (d) The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.
- (e) The terminal box on the module should have a provision for opening for replacing the cable, if required.
- (f) Each PV module must use a RF identification tag (RFID), which must contain the following information:
 - (i) Name of the manufacturer of PV Module
 - (ii) Model or Type Number
 - (iii) Serial Number
 - (iv) Month and year of the manufacture
 - (v) I-V curve for the module
 - (vi) Peak Wattage of the module at 16.4 volts
 - (vii) I_m , V_m and FF for the module
 - (viii) Unique Serial No and Model No of the module

Until March 2013, the RFID can be inside or outside the module laminate, but must be able to withstand harsh environmental conditions. **However from 1st April 2013 onwards; RFID shall be mandatorily placed inside the module laminate.**

- (g) **A distinctive serial number starting with NSM will be engraved on the frame of the module. The distinctive number starting NSM will also be screen printed on the tedral sheet of the module.**

2) BATTERY

- (i) The battery will be Lead Acid, Tubular positive plate flooded electrolyte or Gel or VRLA Type.
- (ii) The battery will have a minimum rating of 12V, 20 or 40 or 75 Ah (at C/10) discharge rate depending on Model.
- (iii) 75 % of the rated capacity of the battery should be between fully charged & load cut off conditions.

3) LAMPS

- (i) The lamp should be a 9 and 11 Watt compact fluorescent lamp (CFL) with 4 pins only along with proper pre-heating circuit.
- (ii) The light output from the lamps should be around 600 ± 5 % lumens (for 9 W CFL) and 900 ± 5 % lumens (for 11 W CFL).
- (iii) The lamps should be housed in an assembly suitable for indoor use, with a reflector on its back. While fixing the assembly, the lamp should be preferably held in a base up configuration.

- (iv) No blackening or reduction in the lumen output by more than 10% should be observed after 1000 ON/OFF cycles (two minutes ON followed by four minutes OFF is one cycle).

4) ELECTRONICS

- (i) The inverter should be of quasi sine wave/sine wave type, with frequency in the range of 20 - 30 kHz. Half-wave operation is not acceptable.
- (ii) The total electronic efficiency should not be less than 85 %.
- (iii) The idle current consumption should not be more than 10 mA

5) DC FAN

The wattage of the fan should not be more than 20 Watts and it should operate at 12V DC.

6) ELECTRONIC PROTECTIONS

- (i) Adequate protection is to be incorporated under no load i.e. when the lamps are removed and the system is switched ON.
- (ii) The system should have protection against battery overcharge, deep discharge condition.
- (iii) Fuses should be provided to protect against short circuit conditions.
- (iv) Protection for reverse flow of current through the PV module(s) should be provided.
- (v) Electronics should have proper temperature compensation for proper charging of the battery throughout the year

7) MECHANICAL COMPONENTS

- (i) Metallic frame structure (with corrosion resistance paint) to be fixed on the roof of the house to hold the SPV module(s). The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that it can be installed at the specified tilt angle.
- (ii) A vented metallic/ plastic box with acid proof corrosion resistance paint for housing the storage battery indoors should be provided.

8) OTHER FEATURES

- (i) The system should be provided with 2 LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged (It should stop glowing when the battery is fully charged).

- (ii) Components and parts used in solar home systems should conform to the latest BIS specifications, wherever such specifications are available and applicable.
- (iii) **The complete Solar Home System (including the battery) will be warranted for a period of two years from the date of supply.** PV modules used in Solar Home Lighting System must be warranted for their output peak watt capacity, which should not be less than 90% at the end of Twelve (12) years and 80% at the end of Twenty five (25) years.

The Warranty Card to be supplied with the system must contain the details of the system supplied. The manufacturers can also provide additional information about the system and conditions of warranty as necessary.

- (iv) Necessary lengths of wires/ cables, switches suitable for DC use and fuses should be provided.
- (iv) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the Solar Home System. The following minimum details must be provided in the Manual:
 - Basic principles of Photovoltaics
 - A small write-up (with a block diagram) on Solar Home Lighting System - its components, PV module, battery, electronics and luminaries and expected performance.
 - Significance of indicators.
 - Clear instructions about mounting of PV module(s).
 - Clear instructions on regular maintenance and trouble shooting of the Solar Lantern.
 - DO's and DONT's.
 - Name and address of the contact person for repair and maintenance.

WHITE LED BASED SOLAR HOME LIGHTING SYSTEMS:

A LED based solar home lighting system aims at providing electricity for operating LED lights and other small DC loads for specified hours of operation per day.

White Light Emitting Diode (W-LED) is a solid state device which emits light when electric current passes through it. A LED based solar Home lighting system consists of a PV Module, control electronics, battery, and W-LED based Luminaires. The battery is charged by electricity generated through the PV module during the day time and the luminaires provide the light as and when required.

- BROAD PERFORMANCE PARAMETERS**

The broad performance specifications of a W-LED light source based solar home lighting system are given below:

Light Source	White Light Emitting Diode (W-LED)
Light Out put	White colour (colour temperature 5500 $^{\circ}$ -6500 $^{\circ}$ K) Minimum 15 LUX when measured at the periphery of 2.5 meter diameter from a height of 2.5 meter. At any point within area of 2.5mtr diametre periphery the light level should not be more than three times of the periphery value. The illumination should be uniform without dark Bands or abrupt variations and soothing to the eyes. Higher output would be preferred.
Mounting of light	Wall or ceiling
Electronics	Min 85 % efficiency
Average duty cycle	5 hours a day
Autonomy	3 days (Minimum 12 operating hours per permissible discharge)

There will be four models of W-LED home lighting systems. The configuration of each model is as follows:

Model-I One White LED lumaniare

PV Module 6 Wp under STC, measured at 16.4V as Vload. Module Voc minimum of 21V. Battery Sealed maintenance free, 12V-7 AH @ C/20, Max DoD- 75%

Model- II Two White LED lumanaire

PV Module 12 Wp under STC, measured at 16.4 V as Vload. Module Voc minimum of 12V. Battery Lead acid flooded or VRLA, 12V - 12AH @ C/20, Max DoD-75%

Model –III Two White LED luminaire and one DC fan of wattage up to 10 W

PV Module 24 Wp under STC, measured at 16.4 V as Vload. Module Voc minimum of 21V. Battery Lead acid flooded or VRLA, 12V- 20AH @ C/20, Max DoD-75%

Model –IV Four White LED

PV Module 24 Wp under STC, measured at 16.4 V as Vload. Module Voc minimum of 21 V. Battery Lead acid flooded or VRLA, 12 V- 20 AH @ C/20, Max DoD-75%

- **Other Details**

1) DUTY CYCLE

The LED solar home lighting system should be designed to operate for average 5 hours a Day and fan for 3-4Hrs, under average daily insolation of 5.5 kWh/sq.m. on a horizontal surface.

2) LIGHT SOURCE

- (i) The light source will be of white LED type. Single lamp or multiple lamps can be used. The colour temperature of W-LEDs used in the system should be in the range of 5500oK–6500oK. Use of LEDs which emit ultraviolet light will not be permitted.
- (ii) The light output from the W-LED light source should be constant throughout the duty cycle.
- (iii) The lamps should be housed in an assembly suitable for indoor use with an appropriate heat sink to dissipate heat generated during operation. The temperature of LED should not increase more than 10o above room temperature. This condition should be complied for 5 hours of operation of the lamp at a stretch while battery operating at any voltage between the load disconnect and the charge regulation set point.
- (iv) The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system must be furnished to the Test Centers and to the buyers. In absence of this data the solar home lighting system may not be tested by the Test Center.

3) BATTERY

- (i) Sealed Maintenance Free or Tubular positive plate lead acid Flooded or VRLA battery. Battery should conform to latest BIS standards. In view of non-availability of adequate test facilities for testing as per BIS standard in the country, existing facilities of battery manufacturers will be utilized by way of periodic quality audit by MNRE/BIS or their representative to ensure conformance of BIS standards.
- (ii) Also initially for a period of six months from the date of the issue of these guidelines capacity test, Ampere-Hour (Ah) & Watt-Hour (Wh) efficiency test and charge retention tests per BIS standards may be used.

- (iii) It is also mandatory for the battery manufacturers/ bulk users to comply with batteries (Management and handling) Rules 2001 of MOEF, as amended.
- (iv) At least 75% of the rated capacity of the battery should be between fully charged and load cut off conditions.

4) ELECTRONICS

- (i) The total electronic efficiency should be at least 85 %.
- (ii) Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery throughout the year.
- (iii) The light output should remain constant with variations in the battery voltages.
- (iv) Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.

5) PV MODULE

- (a) The PV module (s) shall contain mono/ multi crystalline silicon or thin film solar cells. In case of crystalline silicon solar cell module it is required to have certificate for the supplied PV module as per IEC 61215 specifications or equivalent National or International Standards whereas in case of thin film solar cell module it is required to have certificate for the supplied PV module as per IEC 61646 specifications or equivalent National or International Standards. In case of thin film modules for each model the modules should fulfill the wattage criterion after light soaking degradation.

In case the supplied PV module is not a module of regular production of the manufacturer and does not have certificate as above then the manufacturer should have the required certification for at least one of the irregular modules. Further, the manufacturer should certify that the supplied module is also manufactured using same material, design and process similar to that of certified PV module.

In case of imported modules it is mandatory to provide a copy of the international product qualification certificate to the test centre

- (b) The power output of the PV module must be reported under standard test Conditions (STC) at 16.4 Volt loading voltage. I-V curve of the sample module should be submitted to the Test Center at the time of system qualification testing.
- (c) The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.
- (d) The terminal box on the module should have a provision for opening for replacing the cable, if required.
- (e) Identification and Traceability: Each PV module used in any solar power project must use a RF identification (RFID) tag. The following information must be mentioned in the RFID used on each module (This can be inside or outside the laminate, but must be able to withstand harsh environmental conditions).

- a) Name of the Manufacturer or distinctive Logo
- b) Model or Type No.
- c) Serial No.
- d) Year of manufacture

6) ELECTRONIC PROTECTIONS

- 1. The system should have protection against battery overcharge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.
- 2. Fuses should be provided to protect against short circuit conditions.
- 3. A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the PV module(s). In case such a diode is not provided with the PV module, full protection against open circuit, accidental short circuit and reverse polarity should be provided.
- 4. Electronics should operate at 12 V and **should have temperature** compensation for proper charging of the battery throughout the year.

7) MECHANICAL COMPONENTS

- (i) Metallic frame structure (with corrosion resistance paint) to be fixed on the roof of the house to hold the SPV module. The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45 degree, so that it can be installed at the specified tilt angle.
- (ii) It should be possible to mount the light source on a wall or ceiling or hang it from the ceiling in a stable manner.
- (iii) A vented plastic/ wooden/ metallic box with acid proof corrosion resistance paint for housing the storage battery indoors should be provided.

8) OTHER FEATURES

- (i) The system should be provided with two LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged.
- (ii) There will be a Name Plate on the system body which will give:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Model Number
 - (c) Serial Number
 - (d) Year of manufacture

9) QUALITY AND WARRANTY

- (i) Components and parts used in W-LED based solar home lighting systems should conform to the latest BIS/ International specifications, wherever such specifications

are available and applicable. A copy of the test report/ certificate stating conformity of BIS/ International standards must be submitted to the Test Centre.

- (ii) The PV module will be warranted for a minimum period of 20 years from the date of supply. The W-LED solar home lighting system (excluding the battery) will be warranted for a period of at least 5 years from the date of supply.
- (iii) The sealed maintenance free battery should be warranted for a period of at least two year (DOD 25 to 30%). The lead acid flooded type battery or VRLA battery should be warranted for a period of 5 years.
- (iv) The manufacturers of W-LED based solar home lighting system are required to provide to the Test Center a detailed report on the tests performance by them and the actually measured values of PV module, electronics, LEDs and battery and other related parameters, as per MNRE specifications. Mere mention of compliance to MNRE specifications is not acceptable and such samples may not be tested by the Test Center.

10) DOCUMENTATION

An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar home lighting system.

The following minimum details must be provided in the Manual:

- (a) About Photovoltaics.
- (b) A small write up (with a block diagram) on PV Module, electronics, lamps and battery.
- (c) About W-LED solar home lighting system - its components and expected performance.

The make, model number, country of origin and technical characteristics of W-LEDs should be stated in the product data sheet.

- (d) Clear instructions about mounting of Pole, Grouting details, fixing of PV module, battery box and luminaire. Clear wiring instructions with line diagram.
- (e) About significance of indicators.
- (f) DO's and DONT's.
- (g) Clear instructions on regular maintenance and trouble shooting of the system.
- (h) Name and address of the person or service center to be contacted in case of failure or complaint.

TECHNICAL SPECIFICATION OF SOLAR WATER HEATING SYSTEM

A) Natural Thermosyphon and Pressurized system

Capacity & Temperature: 125 LPD to 3000 LPD and 60⁰C.

Sr. No.	Item and Specifications	Natural Thermosyphon	Pressurized @ 3.5 Kg/Cm ² Thermosiphon
1	Supply of collectors and stand with installation Absorber: cu-cu only. Box Aluminum (ISI Mark Only) IS 12933	As per system capacity	As per system capacity
2	Supply & installation of insulated storage tank with stand	Capacity same As per system capacity	Capacity same As per system capacity
	Material of construction	Stainless steel -304 / C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides	Stainless steel -304 / C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides
	Insulation with thickness of material	Rock wool 100 mm/ PUF 50 mm upto 2000 LPD system	Rock wool 100 mm/ PUF 50 mm upto 2000 LPD system
	Density of insulation	RockWool - 48 kg / m ³	RockWool - 48 kg / m ³
		PUF - 40 kg / m ³	PUF - 40 kg / m ³
	Insulation cover	Aluminum sheet 22 swg	Aluminum sheet 22 swg
3	Supply control instruments with installation	1 set for each system	1 set for each system
	• Tap (Brass Tap)	1 No.	1 No.
	• Gate Valve (Brass, 1inch, ISI Mark)	2 Nos.	2 Nos.
	• Non return valve (ISI Mark)	1 No	1 No
	• Air release valve (ISI Mark)	1 No	1 No
	• Strainer (ISI Mark)	1 No	1 No
	• Pressure Release Valve	NA	1 No
	• Pressure Gauge	NA	1 No
	• Temperature Gauge (4" dial, H Guru make)	1 No (1500 lpd to 3000 lpd)	1 No (1500 lpd to 3000 lpd)
4	Capacity of cold water tank	As per requirement (Minimum capacity of cold water tank shall be equivalent to the capacity of the system e.g. For 125 LPD system Cold Water Tank should be of 125 liter)	As per requirement (Minimum capacity of cold water tank shall be equivalent to the capacity of the system e.g. For 125 LPD system Cold Water Tank should be of 125 liter)
5	Supply of piping G I, Class B, ISI	6 mtr for each system	6 mtr. for each system
	Cold Water - 1 "		
	User piping upto one use point.	30 mtr for each system	30 mtr for each system
	Dia 20 mm (insulated) (Kitec or equivalent slandered make.)		

01. ABSORBER

(A) Material : Absorber shall be of Cu-Cu type only
(Copper Sheet and Copper Tube)

(a) Thickness of Sheet : 34 SWG (0.19 mm) minimum

(b) Risers : Diameter: 12.7 mm (+ 0.5 mm)
Thickness: 24 SWG (0.56 mm)
(+ No limit, - 0.07 mm)

(c) Header : Diameter: Minimum 25.4 mm (OD) + 0.5 mm
Thickness: 0.71 mm (+ no limit -0.07 mm)
Projection: 40 mm (+ 5mm) out side
(Including the collector box flange thickness)

* Number of fins and tubes: Nine / collector

(d) Space between Riser Tubes :

Maximum space between riser tubes shall be 12 cm from centre to centre of the risers. The free edges at the sides should not exceed 6 cm from the centre of the extreme and riser tube. For independent fins or joints in the sheet an overlap of minimum 2 mm shall be provided.

(e) Bonding between Riser and sheet:

Welding may be of continuous nature inert arc spot welding type with the product of number of spots per fin and area of spots exceeding the product of length of the fin and twice the thickness of the fin for each fin. (Continuous welding)

(B) Area of Absorber : 2.0 Sq. M (+0.1 m²) including the projected area of the header.

(C) Header - Riser Joints :

The assembly of risers with the header shall ensure not more than 5 mm tube extension inside the header. The riser shall be brazed to the header with suitable brazing alloys with or without the use of flux.

Any flux used in soldering/ brazing shall be mechanically removed and neutralized with the solution of sodium carbonate to avoid corrosion problem in future.

(D) Absorber Coating :

Selectively coated with solar absorptive more than 0.92 and infrared emissive less than 0.20 shall be used. The coating should be stable up to 300 °C.

02 FLAT PLATE COLLECTORS:

(a) Overall Dimensions of the Collector Box : a) Length = 186 cm (+1cm) / 212 cm (+ 1 cm) / 205 cm (+ 1 cm)
b) Breadth = 124 cm (+1cm)/104cm (+ 1 cm) / 93 cm (+ 1 cm)
c) Height = 10 cm (+1 cm) / 10 cm (+ 1 cm) / 9.3 cm (+ 1 cm)

(b) Collector Box Materials : Excluding glass and glass retainer

(i) Aluminum:
Aluminum extruded sections of size approximately 100 mm x 25 mm channel sections and of thickness 1.6 + 0.2 mm
Aluminum sheet for the bottom shall be of thickness 0.71 + 0.07 mm
Aluminum Sheet for entire body shall be of 1.0 mm thickness (minimum) 1.2 mm thick Aluminum angle (dimensions 25 mm x 25 mm) as a retainer for glass.

(ii) Fabrication of the Box:
Side Channels shall be welded by inert arc gas welding or gas brazing to ensure leak proof continuity of the joints of the box.

(iii) Attachment of Bottom sheet:
Bottom sheet shall be attached by riveting, spot welding or with S.S. screws and caulking of the joints with sealing paste of Zinc Oxide based or rubber based or silicon rubber based epoxy based sealing compounds. Caulking may be done on the inside joints or inside as well as outside joints or inside as well as outside joints to ensure leak proof joints.

(iv) The complete aluminum box should be powder coated or anodized.

03 Testing of Riser - Header Assembly:

It will be tested for leakage and strength at a minimum hydraulic / pneumatic pressure of 5 kg/cm² for all thermos phonic systems and systems designed for operation at 2.5 kg / cm² or below. For systems designed for operation at higher pressure, test pressure shall be twice the system design pressure.

04 COLLECTOR BOX INSULATION:

(a) Back Insulation:

Insulation of R value = 1.67 m² C /W to withstand a temperature of 250⁰ C should be used.

Typical insulations are:

Sr. No.	Trade Name	K	(kg/m³)	R	Minimum thickness
1.	Spintex 300 (Rock wool)	0.029	48	1.67	50 mm
2.	Twig Glass wool	0.033	48	1.67	65 mm

Aluminum foil of thickness 0.016 mm + 0.005 mm shall be used for covering the back insulation.

(b) Side Insulation:

Resin bonded white glass wool/Rigid polyurethane/ industrial grade spintex shall be used. So as to achieve R value = $1.67 \text{ m}^2 \text{ }^\circ\text{C/W}$. Typical insulation is as given in 4 (a).

The side insulation shall be 15 mm thick (minimum). Aluminum foil of thickness 0.016 mm to 0.015 mm shall be used for covering the side insulation.

05 FRONT GLAZING:

4 mm thick + 0.2 mm toughened / tempered (Hardened) glass having transitivity of 85% or more shall be used. In hilly region only toughened glass of 4mm / 5mm of transitivity 82% or more should be used.

06 HEADER FLANGES:

- Brass flanges of 62 mm + 3 mm diameter and minimum thickness of 4 mm with provision for four numbers of SS / GI or cadmium plated bolts with diameter of 5 mm - 6 mm shall be used. Flanges shall be brazed to the header and brazing tested for leakage at the test pressure. In no case crude soldered flanges shall be used. The assembly of the flanges should be at right angle to the header area to ensure proper assembly at the site of installation.

07 GROMMET:

Suitable sealing between the inlet and outlet of header and casing of the following materials shall be provided,

Neoprene, EPDM, Silicon Rubber and Butyl Rubber.

The grommet shall be suitable for a temperature upto 150°C and mechanical loading during transportation of collectors. Typical size of grommet may be 40 mm outer dia. and 25 mm inner dia.

08 ASSEMBLIES OF COLLECTORS:

The load of the absorber should not be on the insulation. It should be taken by the collector box.

The air gap between the glazing and the absorber should be 30 mm (+5 mm).

Insulation should not be allowed to slide one of the ways is to provide extra glass wool pad below the header to clamp the back insulation pad between the header and the collector box. Glazing shall be fixed on the collector box by using EPDM channels /sponge rubber strips both at the top and bottom of the glass.

The glass should be firmly held, without strain, taking into account the expansion of glass. A typical while fixing the screws on the top of the box example is by retaining the glazing with the help of stainless steel screws and aluminum angle retainer of dimensions 25 mm x 25 mm x 1.6 mm fixed on the top of the box it shall be ensured that the screws are not touching the glass edge.

Top surface along the edge between the glass and the aluminum angle shall be sealed with suitable sealants such as zinc oxide based / rubber based / silicon rubber based and polysulphide rubber sealants.

09 GASKET FOR FLANGES:

3 mm thick compressed asbestos fiber gasket or Neoprene rubber or EPDM gasket shall be used for sealing the joints between flanges.

10 COLLECTOR SUPPORT FRAME:

The structure should be in a position to withstand a wind velocity of 100 Kms /Hr. A typical way to do this is that it shall be made with angle iron stronger than 35 mm x 35 mm x 3 mm and shall have vertical support at top and bottom edge of the inclined plane of the collector at a distance of 2.5 m or less. The vertical support shall be firmly grouted to the roof in the ground in case of ground mounted system. The grouting blocks shall be of minimum equal to 25 cm x 25 cm x 15 cm and finished properly. In case the grouting is carried out on a roof already water proofed with asphalt the back support of the collectors may be anchored to the parapet or the size of the grouting block shall be increased to provide for a dead weight anchoring of 75Kg per leg of the vertical support. Other alternative may be got approved from Director General, MEDA, Pune.

11 PAINTING OF STANDS:

Proper cleaning and degreasing of the surface should be done before painting. Two coats of zinc chromatic red oxide primer shall be applied followed by one coat of enamel paint of suitable color. For coastal areas and areas of sulphuric fumes and chlorides suitable anti-corrosion paints like polyurethane paint or epoxy paint should be applied after proper treatment in shop.

The manufacturer may use Zinc plated stand as it has longer life.

12 STORAGE TANK

(A) Material: De-Pressurized

The tank shall be made up of stainless steel or C.R.steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides.

The storage tank for 125/ 250 liters capacity shall be made of 22 SWG stainless steel only. Copper tank of thickness 20 SWG may also be used. However, proper precautions shall be taken in case of higher heads.

Between 250 to 500 liters capacity the storage tank shall be of stainless steel of thickness 20 SWG, for 500-1500 liters, it shall be of 16 SWG, for 1500- 3000 liters, it shall be of 14 SWG and for capacity more than 3000 liters it shall be of 10 SWG thickness or more with proper stiffening.

Support structure shall be designed properly to withstand the load of the Storage Tank, wind speed and the stored water.

Material: Pressurized@3.5 kg/cm²

The tank shall be made up of stainless steel or C.R. steel sheets with MNRE approved corrosion protection for hard water / water with chloride & fluorides.

The storage tank for 125/ 250 liters capacity shall be made of 16 SWG stainless steel only.

Between 250 to 500 liters capacity the storage tank shall be of stainless steel of thickness 14 SWG, for 500-1500 liters, it shall be of 12 SWG, for 1500-3000 liters, it shall be of 10 SWG and for capacity more than 3000 liters it shall be with proper stiffening & with standing strength.

Support structure shall be designed properly to withstand the load of the Storage Tank, wind speed and the stored water.

(B) Insulation:

Insulation of R value = $3.34 \text{ m}^2 \text{ }^{\circ}\text{C}/\text{W}$. to withstanding a temperature of $100 \text{ }^{\circ}\text{C}$. Should be used. Typical insulations are: -

Sr. No	Trade Name	K (W/ mk)	Density (kg/m ³)	R	Minimum Thickness
1.	RockWool	0.029	48	3.34	100 mm

RockWool insulation with the same density will be permitted for the use. Thin polythene sheet shall be used as covering between the rockWool and the cladding sheet besides the retaining material such as chicken mesh etc.

13 PIPING:

(A) Material:

Medium class (B class) GI as per IS 1239 shall be used for piping. Brand for piping to be used must be of ISI mark only.

(B) Insulation:

Insulation of R = $1.67 \text{ m}^2 \text{ Deg. C/W}$ to withstand a temp. of 100^0 C . shall be used. Typical insulation is as given below,

Sr. No	Trade Name	K (W/ mk)	Density (kg/m ³)	R	Minimum Thickness
1.	RockWool	0.029	48	1.67	50 mm

The Manufacturer can also use PUF insulation of 25 mm for all water heating system pipeline and for hot water tank Puff insulation is of 50 mm.

Thin plastic sheet shall be used as covering between RockWool and aluminum cladding besides other retaining material 26 SWG aluminum sheet shall be used for cladding the insulated pipe.

14 VALVES / NIPPLES / TEES / BENDS:

Gunmetal valve as per ISI specification shall be used.

Nipple/Tees and bends shall be of medium class GI (B class).

Gunmetal valve in each row shall be provided. Air vents in each row are to be provided. Valve should be of chrome plated 90° rotation ball valve should be used having standard brand.

15 Those items, which are exposed to the air and likely to be corroded, therefore should be treated with anti corrosive treatment i.e. application of epoxy painting.

16. The system shall be supplied and installed with ISI mark, Cu-Cu selectively black chrome coated only or Cr-Al selective coating of International standard and with BIS approval.

17. All the joints should be flanged-type / union type with proper temperature gaskets. Rubber joints will not be accepted. Bolts and nuts used in the joints should be adequately protected against corrosion.

18. All pipe lines used should be ISI marked for the hot as well as cold water should be galvanized iron class - B conforming to IS No. 1239.

19. Instrumentation control valves and other accessories should be of high quality and of ISI make with high reliability.

20. All metal parts which are likely to get corroded should be protected by suitable paints.

21. The whole assembly shall be tested hydrolytically to withstand a pressure of 5 kg / sq. cm.

22. All installations including collectors and pipelines are to be supported on suitable permanent metal structural supports designed for the purpose and grouted / bolted properly.

23. Civil Engineering work or construction work of any kind shall be carried out by the Contractor.

24. Angle of response for collector should be latitude plus 15°, facing south with no shadow on neighboring collector rows.

25. All pipe lines carrying hot water above ambient temperature should be insulated with fiber rock wool / mineral wool 50 mm thick with thermal conductivity less than 0.04 K cal/hr-m degree C. or polyurethane of equivalent thickness. Hot water tank should be insulated with 100 mm thick rock wool / mineral wool.

26. The system should be painted with anticorrosive paint. One coat of primer and two final coats should be applied.

27. Scope of work:

a. Design of the system.

b. Fabrication, supply and installation of suitable flat plate collectors.

- c. Design, fabrication, supply and the installation of suitable support for the collectors, pipes, valves and other components and accessories.
- d. Design, supply, fabrication, installation of cold water tank and insulated storage tank, cold water piping, insulated user piping.
- e. Supply and installation of control instrumentation required for the system.
- f. Civil work (grouting) of collectors, collector stands and tank.
- g. Hydraulic testing and commissioning of the system.
- h. Any additional works not covered above.
- i. Supply of manual for Operation and Maintenance to the Maintenance department of concerned beneficiary institute.
- k. Commissioning of the entire system.
- l. Training to the user for operation and maintenance of the system.

3 - B) Solar Water Heating System (Forced flow circulation Type): (Capacity 3000 to 5000 lpd)

Forced Circulation system - The systems between 3000 lpd to 5000 lpd shall operate on forced circulation pattern. The system should operate on differential temp. controller logic. The following should take into consideration while designing the same:

For: Pump Control Panel with DTC

Description	Specification / Make
OLR & MCB	L&T / Siemens
Sensors	RTD PT-100 with SS-304, 12" stem
Motor Selector Switch	L&T / KEC

For: Intercirculation Pumps

Make	Grundfoss / Kirloskar / reputed make
Type	1 Hp
Purpose	Internal Circulation
Quantity	1 + 1 standby

TECHNICAL SPECIFICATIONS FOR SPV SYSTEMS

SPECIFICATIONS FOR SOLAR PHOTOVOLTAIC LANTERN SYSTEMS

I. DEFINITION

A Solar Photovoltaic Lantern is a lighting system consisting of a lamp, battery and electronics, all placed in a suitable housing, made of metal, plastic or fiberglass, and PV module. The battery is charged by electricity generated through the PV module. The lantern is basically a portable lighting device suitable for either indoor or outdoor lighting, covering a full range of 360 degrees. A lighting device, which does not have only omni-directional lighting, will not be classified as a solar lantern in the present context.

II. DUTY CYCLE

The solar lantern should provide a minimum of three to four hours of lighting per day. The actual duration of lighting may vary depending on the location, season, etc.

III. MODELS

The solar lantern should conform to one of the following models:

Sr. No.	Model	Lamp	Battery Capacity AT C/20 Rate	PV Module Rating
12 VOLT MODELS				
	MODEL II-A	CFL 7 W	12 V, 7.00 AH	10.0 to 11.9 Wp
	MODEL II-B	CFL 7 W	12 V, 7.00 AH	12.0 to 14.0 Wp

IV. LAMP

- (a) The lamp will be of compact fluorescent (CFL) type with a rating of 7 Watt.
- (b) For 4 - Pin type CFLs, a suitable pre-heating circuit must be provided.
- (c) The lamp should preferably be mounted in a base up configuration.
- (d) The light output should be 370 +/- 5% lumen for a 7W lamp.
- (e) No blackening or reduction in the lumen output by more than 10% should be observed after 1000 ON/OFF cycles (two minutes ON and four minutes OFF is one cycle).

V. BATTERY

- (a) The battery will be sealed maintenance free lead acid type.
- (b) The Capacity of the battery will be a minimum of 7.0 AH at 12 V at C/20 discharge rate at 27°C.
- (c) Eighty percent of the rated battery capacity (~ 5.6 AH at 12 V, 27°C) should be between the low voltage cut-off and full charge condition of battery.

VI. ELECTRONICS

- i. The inverter will be of quasi sine wave/sine wave type with a crest factor less than 1.7 and the frequency in the range of 20-35 KHz. Half-wave operations is not acceptable.
- ii. The overall efficiency of the control electronics should be at least 85%.
- iii. The idle current (i.e. the current consumed when the lamp is switched OFF and no charging is in progress) should not be more than 1 mA.
- iv. The voltage drop from module terminals to the battery terminals should not exceed 0.6 volts including the drop across the diode and the cable when measured at maximum charging current.
- v. The PCB containing the electronics should be capable of solder free installation and placement.
- vi. The low voltage cut off set point will not be lower than 11 V and the high voltage cut off should be below 14.3 V at 27°C.
- vii. The electronics circuit will be designed to ensure full charging of the battery under different ambient temperatures (0 - 45°C). Further, the electronic circuit should have adequate temperature compensation arrangement for the battery charge regulation set point/ high voltage disconnect for proper charging of the battery throughout the year.

VII. PV MODULE

- (i) The PV module to be used with the solar lantern must have a minimum of 10 Wp at a load voltage of 16.40 ±0.2 V under the standard test conditions (STC) measurement. **The module efficiency should not be less than 12%.**
- (ii) There should preferably be an arrangement (stand) for mounting the module at an optimum angle in the direction facing the sun.
- (iii) The terminal box on the module should have a provision of opening it for replacing the cable, if required.
- (iv) The PV module should have crystalline solar cells and must have a certificate of testing conforming to IEC 61215 Edition II / BIS 14286. The manufacturer should produce the certificate for a higher wattage module, in case the certificate is not available for the offered PV module. Further, the manufacturer should certify that the supplied module is also manufactured using similar material, design and process as that of the certified PV module. The certificate should be from an NABL or IECQ accredited Laboratory.
- (v) The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.
- (vi) A foil/ strip containing the following details should be laminated inside the module so as to be clearly visible from the front side:-
 - a) Name of the Manufacturer and/ or distinctive Logo

- b) Model and/ or Type No.
- c) Serial No.
- d) Year of manufacture

(vii) **A distinctive serial number starting with NSM will be engraved on the frame of the module. The distinctive number starting NSM will also be screen printed on the tedlar sheet of the module.**

VIII. ELECTRONICS PROTECTIONS

- (i) Adequate protection is to be incorporated under no load conditions (e.g. when the lamp is removed and the lantern is switched ON).
- (ii) Battery cut off & reconnects should be provided to protect it against overcharge and deep discharge conditions.
- (iii) A fuse should be provided to protect against short circuit conditions.
- (iv) A blocking diode, preferably a Schottky diode, should be provided as part of the lantern electronics to prevent reverse flow of current through the PV module, in case such a diode is not provided with the module itself.
- (v) Full protection against open circuit, accidental short circuit and reverse polarity should be provided. Switching ON of the System during charging should not be allowed.

IX. INDICATORS

The system should have two indicators one green and the other red. The green should indicate the charging under progress and should glow only when the charging is taking place. It should stop glowing when the battery is fully charged. Red should indicate the battery load cut off condition.

X. WARRANTY/ GUARANTEE

- (i) The complete Solar Lantern will be warranted for five years and the battery must be warranted for a minimum period of Two (2) years.
- (ii) The PV module used in a Solar Lantern must be warranted for its output peak watt capacity, which should not be less than 90% at the end of Twelve (12) years and 80% at the end of Twenty five (25) years.
- (iii) The Warrante/ Guarantee Card to be supplied with the Solar Lantern must contain the details of the system supplied. The manufacturers can provide additional information about the system.

XI. OPERATION and MAINTENANCE MANUAL

An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the Solar Lantern. The following minimum details must be provided in the Manual:

- Basic principles of Photovoltaics.

- A small write-up (with a block diagram) on Solar Lanterns - its components, PV module, battery, electronics and luminaries and expected performance.
- Significance of indicators.
- Clear instructions on regular maintenance and trouble shooting of the Solar Lantern.
- DO's and DONT's.
- Name and address of the contact person for repair and maintenance during the warranty and AMC period.

SPECIFICATIONS OF WHITE LED (W-LED) BASED SOLAR LANTERN

White Light Emitting Diode (W-LED) is a solid state device which emits light when an electric current passes through it. A Solar lantern is a lighting system consisting of PV module, W-LED(s), battery and electronics, all placed in a suitable housing and made of metal/ plastic or fiberglass. The battery is charged by electricity generated through the PV module. The lantern is basically a portable lighting System suitable for either indoor or outdoor lighting, covering a full range of 360 degrees.

BROAD PERFORMANCE PARAMETERS

The broad performance specifications of a white light emitting diode (W-LED) light source based solar lantern system are given below:

Light Source W-LED luminaire, dispersed beam, soothing to eyes with the use of proper optics

Light Output Minimum level of illuminance from W-LED lantern should be as follows:

Sr. No.	Distance in feet	When detector is in horizontal to center point of bottom of light source (in Lux)	When detector is at an angle of 90° to the center point of the bottom of light source (in Lux)
1	1	32.0	105.0
2	2	6.5	32.0
3	3	3.0	16.0
4	4	2.0	9.5
5	5	1.5	6.5

PV Module Between 3 to 5 Wp under STC

Battery Sealed maintenance free Lead acid or NiMH or Lithium Ion, with a capacity up to 7 AH, at voltages up to 12V @ C/20 rate of discharge. Max. DoD 75% or equivalent capacity

Electronics Min 85% total efficiency

Duty cycle 4 hours a day

Autonomy Minimum of 3 days (Minimum 14 operating hours per permissible discharge)

OTHER DETAILS

DUTY CYCLE

The LED solar lantern system should be designed to operate for average 4 hours a day, under average daily insolation of 5.5 kWh/ sq.m. on a horizontal surface.

LIGHT SOURCE

The light source will be of W - LED type. Single lamp or multiple lamps can be used. Wider view angles preferred. The colour temperature of white LEDs used in the system should be in the range of 5500^0K - 6500^0K . Use of LEDs which emit ultraviolet light is not permitted.

- The light output from the W - LED light source should be constant throughout the duty cycle.
- The lamps should be housed in an assembly suitable for in door and outdoor use.
- The make, model number, country of origin and technical characteristics (including IESNA LM-80 report) of W-LEDs used in the lighting system must be furnished to the Test Centers and to the buyers. (In absence of this data the solar lantern may not be tested by the Test Center).

About White LED Lights: The make, model number, country of origin and technical characteristics of LEDs should be stated in the product data sheet and furnished to the Test Centers

BATTERY

- (i) Sealed Maintenance Free (SMF) battery.
- (ii) Battery should conform to the latest BIS standards. In view of non-availability of adequate test facilities for testing as per BIS standard in the country, existing facilities of battery manufacturers will be utilized by way of periodic quality audit by MNRE/ BIS or their representative to ensure conformance to BIS standards.
- (iii) Also initially for a period of six months from the date of issue of these guidelines capacity test, charge efficiency test and charge retention tests as per BIS standards should be used to enable the programme to continue.

- (iv) It is also mandatory for the battery manufacturers/ bulk users to comply with batteries (Management and handling) Rules 2001 of MOEF, as amended from time to time.
- (v) A copy of the test certificate for the battery (including its make, country of origin and model number) used in the system should be provided to the Test Center and buyer.
- (vi) At least 75% of the rated capacity of the battery should be between fully charged and load cut off conditions.

ELECTRONICS

- (i) The total electronic efficiency should be at least 85%.
- (ii) Electronics should operate up to 12 V and should have temperature compensation for proper charging of the battery throughout the year.
- (iii) The light output should remain constant with variations in the battery voltages.
- (iv) Necessary lengths of wires/ cables, switches suitable for DC use and other protections should be provided.

PV MODULE

The PV module (s) shall contain mono/ multi crystalline silicon or thin film solar cells. In case of crystalline silicon solar cell module it is required to have certificate for the supplied PV module as per IEC 61215 specifications or equivalent National or International/ Standards whereas in case of thin film solar cell module it is required to have certificate for the supplied PV module as per IEC 61646 specifications or equivalent National or International Standards. In case of thin film modules for each model the modules should fulfill the wattage criterion after light soaking degradation.

In case the supplied PV module is not a module of regular production of the manufacturer and does not have certificate as above, then the manufacturer should have the required certification for at least one of the irregular modules. Further, the manufacturer should certify that the supplied module is also manufactured using similar material, design and

process as that of the certified PV module.

In case of imported modules it is mandatory to provide a copy of the international product qualification certificate to the test center.

- The power output of the PV module must be reported under standard test conditions (STC) at loading voltage. I-V curve of the sample module should be submitted to the Test Center at the time of system qualification testing. The specified module wattage should be at the applicable load voltage.
- The load voltage of the PV module under STC should be sufficient enough to charge the battery in Indian environmental conditions.
- The terminal box on the module should have a provision for “Opening” for replacing the cable, if required.
- Identification and Traceability
- Each PV module used in any solar power project must use an RF Identification (RFID) tag. The following information must be mentioned in the RFID used on each module (This can be inside or outside the laminate, but must be able to withstand harsh environmental conditions.)
 - a) Name of the Manufacturer or distinctive Logo
 - b) Model or Type No.
 - c) Serial No.
 - d) Year of make

ELECTRONIC PROTECTIONS

- Adequate protection is to be incorporated under no load conditions, e.g. when the lamps are removed and the system is switched ON.
- The system should have protection against battery over charge and deep discharge conditions. The numerical values of the cut off limits must be specified, while submitting the samples for the testing purposes.
- Proper protection should be provided against short circuit conditions.
- A blocking diode should be provided as part of the electronics, to prevent reverse flow of current through the PV module (s).
- In case such a diode is not provided with the PV module, Full protection against open circuit, accidental short circuit and reverse polarity should be

provided.

OTHER FEATURES

- (i) The system should be provided with two LED indicators: a green light to indicate charging in progress and a red LED to indicate deep discharge condition of the battery. The green LED should glow only when the battery is actually being charged.
- (ii) There will be a Name Plate on the Lantern body which will give:
 - Name of the Manufacturer or Distinctive Logo.
 - Model Number
 - Serial Number
 - Year of manufacture

QUALITY AND WARRANTY

- (i) Components and parts used in White LED solar Lantern systems should conform to the latest BIS/ International specifications, wherever such specifications are available and applicable. A copy of the test report/ certificate stating conformity of BIS/ international standards must be submitted to the Test Center.
- (ii) The PV module will be warranted for a minimum period of 20 years from the date of supply. The White LED solar lantern system (excluding the battery) will be warranted for a period of at least 5 years from the date of supply. The battery should be warranted for a period of at least two years.

DOCUMENTATION

An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar lantern system.

The following minimum details must be provided in the manual

- (a) About Photovoltaics.
- (b) A small write up (with a block diagram) on PV Module, electronics, lamp and battery.
- (c) About White LED solar lantern system - its components and expected performance

The make, model number, country of origin and technical characteristics of W- LEDs should be stated in the product data sheet

- (d) Clear instructions about mounting of PV module
- (e) About significance of indicators
- (f) DO's and DONT's
- (g) Clear instructions on regular maintenance and trouble shooting of solar lantern system
- (h) Name and address of the person or service center to be contacted in case of failure or complaint.

SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS (DC Pumps)

A) SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS FOR CAPACITY OF 1 H.P. (SPV Pump) (900 WATT PV Module)

I. DEFINITION

A solar Photovoltaic water pumping system consist of a PMDC surface mounted motor, pump set, electronics if any, interconnect cables, MCB and a PV array mounted on a suitable structure with a provision of single axis manual tracking. Storage batteries will not constitute a part of the SPV water pumping system.

II DUTY CYCLE

The solar PV water pumping system should provide a minimum of 77 liters of water per watt of PV array used per day under average daily solar radiation conditions of 5.5 Kwh/sq.m. on a horizontal surface, from a total head of 10 meters (suction head up to a maximum of 7 meters). In case of deep well submersible pumps, the water requirement should be a minimum of 25 liters of water per watt of PV array capacity used per day from a total depth of 30 meters. Use of a tracking system to enhance the availability of solar radiation to lift desired quantity of water is permitted. The manufacturer of SPV water pumping system is required to specify whether the minimum water out put is achieved directly or though tracking of PV array. The actual duration of pumping of water on a particular day and the quantity of water pumped may vary depending on the location, season etc.

III PV ARRAY CAPACITY

The SPV water-pumping system should be operated with a PV array in the range of $P_{max} = 900$ watts, measured under standard test conditions.

Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. In case of thin film solar cell modules, the specified values of output power refer to the power output achieved after the initial degradation.

IV MOTOR PUMP-SET

Type of motor pump sets are permitted to be used in the SPV water pumping systems:

Surface mounted DC motor pump-set.

1. The wire to water efficiency of the surface motor pump set at 10 meter total head should be at least 40 %. They will also report the wire to water efficiency of the motor-pump set used by them & submit copy of the test report as proof to (MNRE) Solar Energy Centre.

V PROTECTIONS:

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided. Provision should be available for float switch operation to avoid over flow from the storage tank (if any).

VI OTHER FEATURES:

- i) A good reliable MCB is to be provided with the motor pump set. Sufficient size & length of cable should be provided for inter-connection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Model Number.
 - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.
The following minimum details must be provided in the Manual:
 - (a) About Photovoltaic
 - (b) About solar pump
 - (c) About PV module
 - (d) About motor pump set
 - (e) Clear instructions about mounting of PV module.
 - (f) About electronics used in AC motor pump sets, if any
 - (g) DO sand Don'ts,
 - (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
 - (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.
- v) The PV module (s) will be warranted for a minimum period of 10 years from the date of supply and the complete Solar pumping system will be warranted for a minimum period of two years from the date of installation.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

B) SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS FOR CAPACITY OF 2 H.P. (SPV Pump) (1800 WATT PV Module) for giving 10000 LPD vs. 90 m head @ 5.5 kWhr / Sq.m. / day solar irradiation incident in Maharashtra.

I) DEFINITION:

A solar photovoltaic water pumping system consist of a PMDC / BLDC submersible / floating motor pump set, electronics if any, interconnect cables, a MCB / Controller and a PV array mounted on a suitable structure with a provision of single axis manual tracking. Storage batteries will not constitute a part of the SPV water pumping system.

II) DUTY CYCLE:

The solar PV water pumping system should provide a minimum of 77 liters of water per watt of PV array used per day under average daily solar radiation conditions of 5.5 KWh/sq.m. on a horizontal surface, from a total head of 10 meters (Suction head up to a maximum of 7 meters). In case of deep well submersible pumps, the water requirement should be a minimum of 25 liters of water per watt of PV array capacity used per day from a total depth of 30 meters. Use of a tracking system to enhance the availability of solar radiation to lift desired quantity of water is permitted. The manufacturer of SPV water pumping system is required to specify whether the minimum water out put is achieved directly or though tracking of PV array. The actual duration of pumping of water on a particular day and the quantity of water pumped may vary depending on the location, season, etc.

III) PV ARRAY CAPACITY:

The SPV water-pumping system should be operated with a PV array of $P_{max} = 1800$ watts, measured under standard test conditions.

Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts, with adequate provision for measurement tolerances. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. In case of thin film solar cell modules, the specified values of output power refer to the power output achieved after the initial degradation

IV) MOTOR PUMP-SET:

Following types of motor pump sets are permitted to be used in the SPV water pumping systems:

PMDC / BLDC Submersible motor pump set.

1. The wire to water efficiency of the submersible motor pump set should not be less than 50%. The manufacturer of the PV pumping system will submit a declaration that the PV array size has been selected for optimal matching with the motor-pump set to give the desired water out put performance. They will also report the wire to water efficiency of the motor-pump set used by them & submit copy of the test report as proof to (MNRE) Solar Energy Centre.

V) PROTECTIONS:

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided. Provision should be available for float switch operation to avoid over flow from the storage tank (if any).

V) OTHER FEATURES:

- i) A good reliable MCB is to be provided with the motor pump set. Sufficient size & length of cable should be provided for inter-connection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Model Number.
 - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.
The following minimum details must be provided in the Manual:
 - (a) About Photovoltaic
 - (b) About solar pump
 - (c) About PV module
 - (d) About motor pump set
 - (e) Clear instructions about mounting of PV module.
 - (f) About electronics used in AC motor pump sets, if any
 - (g) DO sand Don'ts,
- (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
- (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.
- v) The PV module (s) will be warranted for a minimum period of 10 years from the date of supply and the complete Solar pumping system will be warranted for a minimum period of two years from the date of installation.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

C) SPECIFICATIONS FOR 1 H.P Submersible pump for Bore well (900 W Pump) (675 WATT PV Module)

I) DEFINITION:

A solar Hand pumping system consist of a submersible motor pump set, electronics if any, interconnect cables, a MCB / Controller and a PV array mounted on a suitable structure with a provision of single axis manual tracking. Storage batteries will not constitute a part of the Solar Hand pumping system.

Technical Specifications:

Maximum installation depth. 75 m.

Delivery head above ground (maximum). 6 m

Minimum Yield of hand pump @ 40 stroke/min. approximate 700 LPH

Daily yield at array of 5 – 6 kWh / m Sq. per day 5000 LPD

Wire to water efficiency > 50%

Maximum current input for solar drive 9.5 amps.

Maximum input power to submersible pump 675 Wp

Minimum required array for submersible pump to start 675 Wp

1 X special water chamber

1X solar power submersible pump

Solar panel 675 Wp

Every panel mounted in Aluminum frame and supported by galvanized angle frame and erected on galvanized pipe structure with single axis manual tracking arrangement.

II) Submersible pump

Light weight stainless steel pump and body

1 H.P., 900 W Submersible pump

Option for operating head from 15-90 m

Discharge range from 4500-6000 LPD

Rated speed 500-3600 rpm

Current 9.5 amps (maximum)

Cable 3 X 2.5 sq.mm

Suitable for 100 mm and above dia.

Bore wells Outlet size 32mm

The overall efficiency of the motor pump set at 10 meter total head should be at least 40% and the efficiency of the submersible motor pump set should not be less than 50%.

IV) PV ARRAY CAPACITY:

The SPV water-pumping system should be operated with a PV array of $P_{max} = 675$ watts, measured under standard test conditions. Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts, with adequate provision for measurement tolerances. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. The PV module shall contain mono / multi crystalline silicon solar cells. The PV module shall be as per IEC 61215 (revised) specifications or equivalent National or international standards.

V) MOUNTING STRUCTURES & TRACKING SYSTEM:

To enhance the performance of Solar Hand pumps covered under the programme, it is desirable to use a tracking system. Manual, passive and electronic tracking are permitted. The PV modules will be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 200 km per hour. The support structure used in the pumping system will be hot dip galvanized.

VI) PROTECTIONS:

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided. Provision should be available for float switch operation to avoid over flow from the storage tank (if any).

VII) OTHER FEATURES:

- i) A good reliable MCB is to be provided with the motor pump set. Sufficient size & length of cable should be provided for inter-connection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Model Number.
 - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.
The following minimum details must be provided in the Manual:
 - (a) About Photovoltaic
 - (b) About solar pump
 - (c) About PV module
 - (d) About motor pump set
 - (e) Clear instructions about mounting of PV module.
 - (f) About electronics used in AC motor pump sets, if any
 - (g) DO sand Don'ts,
 - (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
 - (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.
- v) The PV module (s) will be warranted for a minimum period of 10 years from the date of supply and the complete Solar pumping system will be warranted for a minimum period of two years from the date of installation.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of

warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User / MEDA.

SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS (AC Pumps)

A) SPECIFICATIONS FOR SPV WATER PUMPING SYSTEMS (with 900 watt SPV Modules)

I. DEFINITION

A Solar Photovoltaic water pumping system consists of a PMDC surface mounted motor, pump set, controller, electronics, interconnect cables, an MCB and a Solar PV array mounted on a suitable GI structure with a provision of single axis manual tracking. Storage batteries will not constitute a part of the SPV water pumping system.

II DUTY CYCLE

The solar PV water pumping system should provide a minimum of 77 liters of water per watt of PV array used per day under average daily solar radiation conditions of 5.5 KWh/sq.m. on a horizontal surface, from a total head of 10 meters (suction head up to a maximum of 7 meters). In case of deep well submersible pumps, the water requirement should be a minimum of 25 liters of water per watt of PV array capacity used per day from a total depth of 30 meters. Use of a tracking system to enhance the availability of solar radiation to lift desired quantity of water is permitted. The manufacturer of SPV water pumping system is required to specify whether the minimum water out put is achieved directly or though tracking of PV array. The actual duration of pumping of water on a particular day and the quantity of water pumped may vary depending on the location, season etc.

III PV ARRAY CAPACITY

The SPV water-pumping system should be operated with a PV array in the range of $P_{max} = 900$ watts, measured under standard test conditions. Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. In case of thin film solar cell modules, the specified values of output power refer to the power output achieved after the initial degradation.

IV MOTOR PUMP-SET

Following type of motor pump sets are permitted to be used in the SPV water pumping systems:

Surface mounted three phase AC motor pump-set of appropriate ratings which will deliver highest output from given SPV wattage.

V PROTECTIONS:

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided. Provision should be available for float switch operation to avoid over flow from the storage tank (if any).

VI OTHER FEATURES:

- i) A good reliable MCB is to be provided with the motor pump set. Sufficient size & length of cable should be provided for inter-connection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Model Number.
 - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.
The following minimum details must be provided in the Manual:
 - (a) About Photovoltaic
 - (b) About solar pump
 - (c) About PV module
 - (d) About motor pump set
 - (e) Clear instructions about mounting of PV module.
 - (f) About electronics used in AC motor pump sets, if any
 - (g) DO sand Don'ts,
- (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
- (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.
- v) The PV module (s) will be warranted for a minimum period of 10 years from the date of supply and the complete Solar pumping system will be warranted for a minimum period of two years from the date of installation.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

B) SPECIFICATIONS for Submersible pump for Bore well (900 Wp Pump) (900 WATT PV Module) for giving 5000 LPD vs. 75 m head @ 5.5 kWhr / Sq.m. / day solar irradiation incident in Maharashtra.

I) Submersible pump

Light weight stainless steel pump and body
Option for operating head from 15-90 m
Discharge 5000 LPD @ 75 m
Rated speed 500-3600 rpm
Current 9.5 amps (maximum)
Cable 3 X 2.5 sq.mm
Suitable for 100 mm and above dia.
Bore wells Outlet size 32mm

The overall efficiency of the pump at 10 meter total head should be at least and the efficiency of the submersible pump should not be less than 50%.

II) PV ARRAY CAPACITY:

The SPV water-pumping system should be operated with a PV array of P max = 900 watts, measured under standard test conditions. Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts, with adequate provision for measurement tolerances. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. The PV module shall contain mono / multi crystalline silicon / thin film amorphous silicon solar cells. The PV module shall be as per IEC 61215 / IEC 61646 (revised) specifications or equivalent national or international standards.

III) MOUNTING STRUCTURES & TRACKING SYSTEM:

To enhance the performance of Solar Hand pumps covered under the program, it is must to use a tracking system. Manual 3 position tracking is must. The PV modules will be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 200 km per hour. The support structure used in the pumping system will be hot dip galvanized.

IV) CONTROLLER & PROTECTIONS:

Solar Power Conditioning Unit (SPCU) for AC submersible pumps: Proper inversion technology for converting solar DC to three phase AC at highest efficiency and suitable for driving inductive load such as motor. It should also incorporate the mechanism by which Maximum Power Point Tracking (MPPT) is achieved. (Digital Signal Processed Maximum Power Point Tracking to monitor the change in voltage & input power level and automatically adjust the motor speed with varying Sun Intensities to ensure maximum power extraction at all Sun intensities and thus, optimum water output from the pumping system.)

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit, reverse polarity, under voltage, over voltage, ambient of 55

deg C, accidental wire cuts should be provided. The solar power conditioning unit (SPCU) / controller should incorporate following features;

1. Electronic Sensor less Dry running protection:

The pump set is protected against dry running to prevent damage to the pump and motor. Dry run protection is inbuilt in the inverter based on power / current sensing.

2. Automatic start and stop:

The controller starts automatically in morning time sufficient sun intensity is available and should stop automatically in evening in case of low sun intensity. It should also start and stop automatically during cloud passing.

3. Soft starting:

The controller provides for soft start to control in-rush current, which prevents damage to the motor.

4. The controller has sufficient protection against faults like over voltage, under voltage, overload, phase imbalance and Output short circuit protection.

5. The controller does not re-start automatically in case of faults like dry run, phase imbalance, output short circuit; unless attended.

6. Work satisfactorily at an ambient temp. $</= 55^0$ Cent.

V) OTHER FEATURES:

- i) A good reliable circuit breaker suitable for Solar DC use is to be provided with the motor pump set. Sufficient length of cable should be provided for interconnection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Model Number.
 - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.
The following minimum details must be provided in the Manual:
 - (a) About Photovoltaic
 - (b) About solar pump
 - (c) About PV module
 - (d) About motor pump set
 - (e) Clear instructions about mounting of PV module.
 - (f) About electronics used in AC motor pump sets, if any
 - (g) DO sand Don'ts,
 - (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
 - (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.

- v) The PV module (s) will be guaranteed for performance for 25 years as per IEC and warranted against manufacturing defects for a minimum period of 5 years from the date of supply. The complete Hand pumping system will be warranted for a minimum period of two years from the date of installation and its solar part will be guaranteed as given above for solar PV modules, whereas pump part will be guaranteed for 5 years.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

- vi) Any additional works like construction of storage tank, stand post, distribution system, etc. which are not covered above, but necessary for the functioning of the system and required components of the system shall be scope of purchaser / user.

C) Specifications for Spv Water Pumping Systems for Capacity of 2 H.P. (Spv Pump) (1800 Watt Pv Module) for giving 10000 LPD vs. 90 m head @ 5.5 kWhr / Sq.m. / day solar irradiation incident in Maharashtra.

I) Submersible pump

Light weight stainless steel pump and body
2 H.P., 1800 W submersible pump
Operating head 90 m
Discharge 10000 LPD @ 90 m
Suitable for 100 mm and above dia.
Pump Outlet size 50mm

The overall efficiency of the surface pump at 10 meter total head should be at least 40% and the efficiency of the submersible pump should not be less than 35%.

II) PV ARRAY CAPACITY:

The SPV water-pumping system should be operated with a PV array of $P_{max} = 1800$ watts, measured under standard test conditions. Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 75 Watts, with adequate provision for measurement tolerances. Use of PV modules with higher power output (preferably 225 Wp and more) is encouraged to avoid associated power losses and ease of installation & maintenance. The PV module shall contain mono / multi crystalline silicon / thin film amorphous silicon solar cells. The PV module shall be as per IEC 61215 / IEC 61646 (revised) specifications or equivalent national or international standards.

III) MOUNTING STRUCTURES & TRACKING SYSTEM:

To enhance the performance of Solar Hand pumps covered under the program, it is must to use a tracking system. 3 position Manual tracking are permitted. The PV modules will be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 200 km per hour. The support structure used in the pumping system will be hot dip galvanized.

IV) CONTROLLER & PROTECTIONS:

Solar Power Conditioning Unit (SPCU) for AC submersible pumps: Proper inversion technology for converting solar DC to three phase AC at highest efficiency and suitable for driving inductive load such as motor. It should also incorporate the mechanism by which Maximum Power Point Tracking (MPPT) is achieved. (Digital Signal Processed Maximum Power Point Tracking to monitor the change in voltage & input power level and automatically adjust the motor speed with varying Sun Intensities to ensure maximum power extraction at all Sun intensities and thus, optimum water output from the pumping system.)

Adequate protections should be incorporated against dry operation of motor pump set, protection against lightning, hails & storms. Full protection against open circuit, accidental short circuit, reverse polarity, under voltage, over voltage, ambient of 55 deg C, accidental wire cuts should be provided. The solar power conditioning unit (SPCU) / controller should incorporate following features;

1. Electronic Sensor less Dry running protection:

The pump set is protected against dry running to prevent damage to the pump and motor. Dry run protection is inbuilt in the inverter based on power / current sensing.

2. Automatic start and stop:

The controller starts automatically in morning time sufficient sun intensity is available and should stop automatically in evening in case of low sun intensity. It should also start and stop automatically during cloud passing.

3. Soft starting:

The controller provides for soft start to control in-rush current, which prevents damage to the motor.

4. The controller has sufficient protection against faults like over voltage, under voltage, overload, phase imbalance and Output short circuit protection.

5. The controller does not re-start automatically in case of faults like dry run, phase imbalance, output short circuit; unless attended.

6. Work satisfactorily at an ambient temp. $</= 55^{\circ}$ Cent.

V) OTHER FEATURES:

- i) A good reliable circuit breaker suitable for Solar DC use is to be provided with the motor pump set. Sufficient length of cable should be provided for interconnection between the PV array and the motor pump set.
- ii) The following details should be marked indelibly on the motor pump set and the photovoltaic modules:
 - (a) Name of the Manufacturer or Distinctive Logo.
 - (b) Model Number.
 - (c) Serial Number.
- iii) An Operation, Instruction and Maintenance Manual, in English and the local language, should be provided with the solar PV pumping system.
The following minimum details must be provided in the Manual:
 - (a) About Photovoltaic
 - (b) About solar pump
 - (c) About PV module
 - (d) About motor pump set
 - (e) Clear instructions about mounting of PV module.
 - (f) About electronics used in AC motor pump sets, if any
 - (g) DO sand Don'ts,
 - (i) Clear instructions on regular maintenance and trouble shooting of the pumping system,
 - (j) Name & address of the person or Center to be contacted in case of failure or complaint.
- iv) Components and parts used in the solar pumping system including the metallic structures should conform to the BIS specifications, wherever such specifications are available and applicable.
- v) The PV module (s) will be guaranteed for performance for 25 years as per IEC and warranted against manufacturing defects for a minimum period of 5 years from the date of supply. The complete Hand pumping system will be warranted for a minimum period of two years from the date of installation and

its solar part will be guaranteed as given above for solar PV modules, whereas pump part will be guaranteed for 5 years.

The Warranty Card to be supplied by the manufacturers with the system must contain the serial numbers of PV modules, motor pump set, electronics if any and the relevant dates about validity of warranty. The full name and address of contact person(s) for after sales service and warranty obligations must also be stated on the warranty card. A copy of warranty card will be provided to MEDA. The manufacturer can also provide additional information about the system and conditions of warranty as necessary.

To ensure compliance of MNRE specifications, copies of data sheets of the PV modules, motor pump set, system design calculations, installation and O&M manuals and blank warranty cards, pass book for maintaining maintenance records etc. will be supplied by the manufacturers to User / MEDA. A copy of the drawing of the support structure will also be provided to User/ MEDA.

- vi) Any additional works like construction of storage tank, stand post, distribution system, etc. which are not covered above, but necessary for the functioning of the system and required components of the system shall be scope of purchaser / user.